

Refine Search

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(4 AND 3).PGPB,USPT,EPAB,JPAB,DWPI,TDBD.	12
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Search History

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<u>L4</u>	gps near2 (coordinate\$ or signal\$) near4 traffic	61	<u>L4</u>
<u>L3</u>	l1 and L2	4602	<u>L3</u>
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File: USPT

Feb 1, 2005

US-PAT-NO: 6850187
DOCUMENT-IDENTIFIER: US 6850187 B1
** See image for Certificate of Correction **

TITLE: Satellite integrity monitor and alert

DATE-ISSUED: February 1, 2005

INVENTOR-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY
Clark; Ronald H.	Cupertino	CA		

ASSIGNEE-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY	TYPE CODE
Lockheed Martin Corporation	Bethesda	MD			02

APPL-NO: 10/428489 [PALM]

DATE FILED: May 2, 2003

PARENT-CASE:

CROSS REFERENCE TO RELATED APPLICATIONS This application claims priority to U.S. Application Ser. No. 09/813,813, now U.S. Pat. No. 6,603,426 which is incorporated herein for all purposes, and is related to the following United States Patent Applications all filed on the same day as the present application U.S. application Ser. No. 09/813,813: Ser. No. 09/813,812, now U.S. Pat. No. 6,462,707, entitled "Satellite Position Monitor"; Ser. No. 09/813,814, now U.S. Pat. No. 6,606,560, entitled "Beacon for Satellite Registration"; Ser. No. 09/813,810 entitled "Satellite Signal Waveform Monitor".

INT-CL-ISSUED: [07] G01 S 5/02, H04 B 7/185

US-CL-ISSUED: 342/357.06; 701/213, 455/12.1, 455/427

US-CL-CURRENT: 342/357.06; 455/12.1, 455/427, 701/213

FIELD-OF-CLASSIFICATION-SEARCH: 342/357.06, 701/213, 455/12.1, 455/427
See application file for complete search history.

PRIOR-ART-DISCLOSED:

U.S. PATENT DOCUMENTS

 [Search Selected](#) [Search ALL](#) [Clear](#)

PAT-NO	ISSUE-DATE	PATENTEE-NAME	US-CL
<input type="checkbox"/> <u>5046006</u>	September 1991	Revord et al.	

<input type="checkbox"/>	<u>5490076</u>	February 1996	Rawicz et al.
<input type="checkbox"/>	<u>6088571</u>	July 2000	Kane et al.
<input type="checkbox"/>	<u>6320536</u>	November 2001	Sasaki
<input type="checkbox"/>	<u>6429808</u>	August 2002	King et al. 342/357.02

OTHER PUBLICATIONS

Wolf, Onboard Autonomous Integrity Monitoring using Intersatellite Links, Sep. 19-22, 2000, ION GPS 2000, Salt Lake City, UT, pp. 1572-1581.

ART-UNIT: 3662

PRIMARY-EXAMINER: Blum; Theodore M.

ATTY-AGENT-FIRM: Townsend and Townsend and Crew LLP

ABSTRACT:

The present invention is a system for providing GPS users with a high level of confidence in the integrity and accuracy of received GPS signals. The system provides a means for each GPS satellite itself to verify the accuracy and/or integrity of its own operations by calculations and processing internal to the GPS satellite and by crosslink communications with other GPS satellites in the GPS constellation. After a GPS satellite verifies the accuracy and/or integrity of its own signals, the GPS satellite transmits an integrity message to all GPS users in view of the satellite. The integrity message can alert GPS users to a loss of integrity or accuracy in the GPS signals. Alternatively, the integrity message can contain information to correct errors in the GPS signals. The integrity message can be incorporated into the existing GPS navigation message transmitted by GPS satellites, or the integrity message can be transmitted over a separate channel such as the planned L5 band channel.

42 Claims, 3 Drawing figures

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L5: Entry 5 of 12

File: USPT

Feb 1, 2005

DOCUMENT-IDENTIFIER: US 6850187 B1
** See image for Certificate of Correction **
TITLE: Satellite integrity monitor and alert

Brief Summary Text (4):

The Global Positioning System (GPS) consists of 24 earth-orbiting satellites. The GPS satellites broadcast a navigation message via a radio frequency (RF) signal. This signal allows any individual with a GPS receiver to process the GPS signals and determine his or her precise longitude, latitude, altitude, velocity and time anywhere in the world.

Brief Summary Text (8):

Other proposed systems which utilize GPS signals include intelligent highway systems. These intelligent highway systems use GPS signals to manage traffic by providing autonavigation for the automobiles on the freeways. Similar systems have been proposed for trains. Thus, it will be a very important safety issue for these systems to ensure the integrity of the received GPS signals.

Detailed Description Text (15):

A copy of the digital navigation message 102 is stored in a memory 118. The navigation message 102 is then sent to a modulator 103. Modulator 103 encodes the digital navigation message 102 into an RF carrier signal. Modulator 103 outputs an encoded RF signal 105 to transmitter 104. A digitizer 109 digitizes the RF signal 105 and stores digital data representing the waveform of RF signal 105 in a memory 120.

Detailed Description Text (16):

Transmitter 104 outputs a signal 108 to GPS L-band mission antenna 110. Antenna 110 transmits a radio frequency GPS signal 112 to GPS users in view of the satellite. A waveform monitor antenna 114 is mounted on the GPS satellite in a side lobe of the satellite's L-band mission antenna 110 and is constructed to provide more than 60 dB of signal attenuation. Waveform monitor antenna 114 receives the electromagnetic RF signal 112 being transmitted by GPS transmitting antenna 110. The waveform monitor antenna 114 thus allows the GPS satellite to listen to the very signal that it is transmitting.

Detailed Description Text (17):

The waveform monitor receiver 116 receives the RF signal 112 from waveform monitor antenna 114. A waveform monitor processor 128 receives the RF signal 112 from waveform monitor receiver 116. Waveform monitor processor 128 extracts the digital navigation message encoded in the RF signal 112. Waveform monitor processor 128 performs one or both of the following checks: 1) compares the digital navigation message received from the waveform monitor receiver 116 with the digital navigation message stored in memory 118, and/or 2) correlates the waveform of the RF signal 112 received from the waveform monitor receiver 116 with the waveform data stored in memory 120.

Detailed Description Text (20):

As an example of waveform monitor operation, if a transmitter element should fail such as transmitter output amplifier 106, the output of transmitter 104 will be

distorted. The RF signal 112 transmitted to GPS users will correspondingly be corrupted. The waveform monitor receiver 116 will receive this corrupted RF signal 112. Waveform monitor processor 128 will compare the corrupted RF signal 112 to the RF waveform data stored in memory 120. Waveform monitor processor 114 will also attempt to extract a digital navigation message from corrupted RF signal 112 and compare it to the digital navigation message stored in memory 118. By performing these comparisons, the waveform monitor processor 128 should thereby detect that the transmitted RF signal 112 is corrupted.

Detailed Description Text (21):

The waveform monitor antenna 114, as just described, monitors the RF signal transmitted from GPS L-band mission antenna 110. However, as an alternative, the waveform monitor 116 could monitor the transmitted waveform in other ways. For example, the waveform monitor 116 could tap off the output of transmitter output amplifier 106, and thus monitor the signal 108 coming out of the transmitter output amplifier 106 (this is indicated by the dotted arrow). This signal could then be compared to the data stored in memories 118 and memories 120. It is also possible that the signal could be stored in memory at different locations than the locations shown in FIG. 1. For example, signal 102 between processor 100 and modulator 103 could be stored in memory, and later verified. In this way, the waveform monitor could isolate which portion of the system was producing a distorted waveform, and thereby identify the malfunctioning component. The waveform monitor system just described could also be used on other systems besides GPS satellite systems. The waveform monitor could be used on other types of satellite systems, or more generally space vehicles or any transmitting system to verify the integrity of the transmitted signal.

Detailed Description Text (37):

The RF signal pulse emitted by beacon 302 is detected by sensors on the GPS satellites 300. The RF signal pulse is decoded and processed onboard each GPS satellite 300. Each GPS satellite 300 calculates beacon position data such as the distance between the GPS satellite 300 and beacon 302. Each GPS satellite 300 then transmits the beacon position data to the other in-view GPS satellites via inter-satellite links 304. The beacon position data allows each GPS satellite 300 to calculate the relative position of beacon 302. This process can be repeated as frequently as is necessary to provide the desired accuracy.

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